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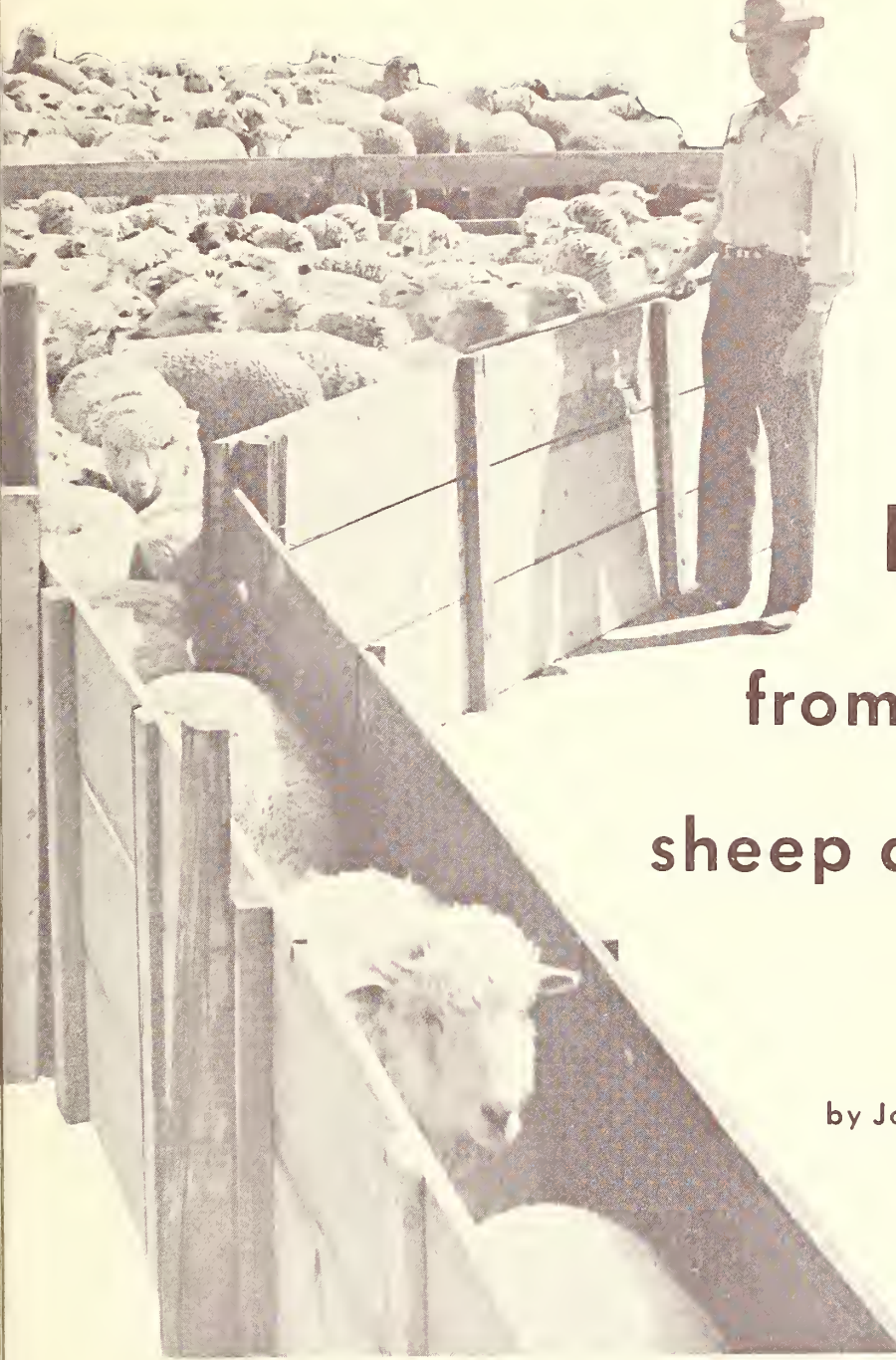
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Marketing Research Report 544

July 1962



# LOSSES

from handling  
sheep and lambs

by Joseph E. Rickenbacker

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Farmer Cooperative Service  
United States Department of Agriculture  
Washington 25, D. C.

Joseph G. Knapp, Administrator

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, financing, merchandising, product quality, costs, efficiency, and membership.

The Service publishes the results of such studies; confers and advises with officials of farmer cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

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This study was conducted under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

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## Summary

**L**osses occurring at the market level during transporting and handling sheep and lambs for marketing and processing averaged 12.75 cents a head in 78 slaughter tests. Over 14,000 head of sheep and lambs were involved in these tests. On a nationwide annual basis, this would amount to almost \$2 million, using average prices in the 6-year period, 1954-1959, inclusive.

Seven packing plants in four mid-western States cooperated in these slaughter tests, a part of the research on transportation and handling of sheep and lambs conducted by Farmer Cooperative Service. This research, covering a 16-month period beginning in 1960, continued the series of studies dealing with livestock loss and damage begun by FCS in 1954 to help farmers and their cooperatives deal with this problem.

In addition to cooperation by packers, the research had the active cooperation and participation of Livestock Conservation, Inc., and of producers, marketers, and transporters.

To arrive at the total loss figure, we considered losses from death in transit; condemnation of carcasses, organs, or parts; and carcass bruise damage. Almost 50 percent of the total loss was attributed to condemnations -- a relatively higher percentage of condemnation loss than in any other species studied. The remaining half of the 12.75 cents a head was divided between bruise loss and death loss, with bruise loss roughly twice the greater.

These losses became more significant on the basis of carcass weight of sheep and lambs compared with that of hogs or cattle. Thus, the loss was 12.75 cents on about 45 pounds of lamb and only twice as much on 158 pounds of pork, with the difference on beef even greater.

The test lots originated in the principal producing areas of the West or at feedlots in the Corn Belt. Lots were selected to provide various grades, types, and weights of animals moving by different modes of transportation from a variety of geographical areas to nearby and distant slaughtering points.

The dead-on-arrivals in the test shipments amounted to 16.45 animals per 10,000 head. This figure might be somewhat low in view of the timing of the tests. Losses from death in transit usually run highest during the winter and early spring, while these tests were conducted from September to mid-December. The loss was significant, however, since it amounted to \$2.19 per hundred head.

Pneumonia caused about 30 percent of the loss from condemnations, with arthritis and uremia also major causes. Just under 10 percent of the loss resulted from carcass bruise injury. Over 14 percent of all the livers of animals in the test loads were condemned because of worms or parasites -- the largest loss area from condemnations.

Two special causes of condemnation were of grave concern -- caseous



lymphadenitis and emaciation in the case of ewes, and damage to tissue or parts of many sheep and lambs by awns or stickers of various grasses such as wild oats, foxtail, and needle grass. These special conditions were related to husbandry practices but constituted a major loss at the market level.

Hind legs had the largest number of bruises requiring trimming away of tissue. Likewise, a higher percentage of total devaluation loss on carcasses was related to leg bruises. The cost of each leg bruise was figured as 43 cents, as compared with a cost of 19 cents for shoulder bruises. A disproportionate number of bruises on the neck occurred because of changes in slaughter procedures and techniques in the industry at the time of the tests. The number of bruises of this type, associated with slaughter, declined as employees gained proficiency in the new techniques.

Some differences existed between market level losses in rail and truck shipments. Death loss was about 50 percent higher on rail shipments, but bruise loss was twice as high on truck shipments. Comparing results was complicated by the disparity in lengths-of-haul between the two types of carriers, with rail shipments moving almost three times as far as truck shipments.

In length-of-haul tests, the loss rate was \$9.67 per 100 head on shipments moving under 300 miles, but was \$19.26 on those shipments moving 300 to 600 miles and remained relatively high, \$16.52, in the next 300-mile block. The same sort of relationship prevailed when in-transit shrink was related to distance hauled. Based on the same mileage blocks used in analyzing loss rates (300 miles), shrink rose from 3 percent to 5.5 per-

cent and then to 7.5 percent.

Overall losses were almost equal on lambs grading Choice and Good. There were too few Prime lambs in the tests for valid analysis. The loss on ewes, however, was about six times higher than on lambs. Lighter weight sheep and lambs suffered higher losses in all categories than did heavier animals. This relationship was true for the few Primes in the tests.

The record of handling on test shipments, supplemented by the general surveys and observations, showed a relationship between loss and damage from bruising and certain handling practices and conditions.

While stationary facilities were generally good at most points, loss occurred from carelessness in placing cross-overs between stationary and mobile facilities, allowing for slips and falls. Likewise, the increase in triple-deck trucks posed a problem since facilities at most yards and plants were not equipped to handle this type vehicle and makeshift measures did not provide safe handling. Some yards are now installing special facilities to handle triple-deck trucks.

The major hazard on railroad stock cars was broken or split side rails hanging or protruding in the car. Less than 5 percent of the cars had defective floors.

In over two-thirds of the trucks with cripples or deads on arrival at a major concentration point, certain loss-associated conditions prevailed. These loss conditions were improper loading (generally overcrowding); improper or inadequate bedding; ventilation that was too much, too little, or poorly and

dangerously controlled or directed; and abusive handling. This last condition existed in 56 percent of the loss loads.

We observed abusive use of persuaders (sticks, canes, whips, and the like) in three-fourths of the trucks arriving with dead or crippled animals. Other types of abuse were kicking by handlers; forcing or hurrying animals excessively, resulting in pile-ups, slips, and falls; making lambs jump from upper decks or throwing them out of the truck to "start the load off"; lifting by the wool, and pulling lambs out of the truck by a leg.

In two-thirds of the cases where handling abuse was noted, we observed two or more of these abuses. Virtually all handling abuse was associated with efforts to hurry the unloading of the vehicle. Unfortunately, the opposite result was usually the case. It actually took longer to unload the truck than would have been required otherwise. While we have been discussing results of a truck survey,

many of these abuses also occurred to some degree in rail shipments.

Improving the handling of sheep and lambs during marketing and processing could reduce loss and damage and result in increased income to the various segments of the industry. Improved handling on ranges, farms, and feedlots could also help, particularly in reducing some condemnation loss.

Handlers who like a particular species usually manage those animals best. This was particularly true of sheep and lambs.

However, good handling can be given by those who understand and appreciate the peculiarities of the species. Again, this is especially true of sheep and lambs. The follow the leader instinct, so obvious in this species, may be regarded as stupidity by indifferent handlers. Other handlers will use this trait to help them manage their animal charges.

# Losses From Handling Sheep and Lambs

by Joseph E. Rickenbacker

*Transportation Branch  
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**E**ach year the livestock industry loses more than \$50 million through loss and damage to animals during handling and transportation in marketing and processing. Various segments of the livestock industry share these losses in whole or in part at one time or another.

Livestock producers and their marketing cooperatives, an important segment of the industry, are interested in more efficient methods of marketing and processing meat animals. One important way to promote efficient marketing and processing is to drastically reduce or eliminate handling and transportation losses.

To assist farmers and their cooperatives in dealing with this loss problem, Farmer Cooperative Service began a series of research studies on livestock handling loss and damage in 1954. This study is the latest in the series.<sup>1</sup>

Some recent studies dealt with the relationship of various handling conditions

and practices to losses and identified "loss-associated" conditions. These studies also suggested how to improve handling techniques and procedures.

Important savings can be made by conforming to safe handling standards.

Interest in the commercial production of sheep and lambs has declined in recent years. An indication of this is provided by the U. S. Department of Agriculture's inventory of livestock on January 1 each year which shows that the number of sheep and lambs on farms in the United States has declined from a high of over 56 million head in 1942 to less than 32 million head as of January 1, 1962.

No single reason can be given for this major decline in the number of sheep and lambs. But losses incurred in producing, marketing, and processing sheep and lambs have contributed to the decision of many "to get out of the sheep and lamb business."

Efforts have been made to stimulate demand for wool and to encourage and increase the consumption of lamb and mutton. While some success has been obtained, the future would be brighter if greater margins could be assured producers, marketers, and processors, along

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<sup>1</sup>Complete reports on the research done by Farmer Cooperative Service are included in the list of publications on the back cover of this report.



with lower prices for consumers. Reducing or eliminating handling and transportation losses would go a long way toward

attaining these goals. This study provides information which could help the industry regain its vigor and prosperity.

## Project Methods

In determining objectives, procedures, and techniques used in this project, we were guided by experience and the advice and counsel of producers, marketers, transporters, and packers. Principal field work took place from September to December 1960, with some follow-up in the spring of 1961.

The seven cooperating slaughter plants we selected were located in Nebraska, Colorado, Iowa, and Minnesota. Plant sizes ranged from a kill of 50 head an hour to 250 head an hour.

Figure 1 indicates the origin points of livestock shipments. Their diversification gave us an adequate sample of sheep and lambs from the major producing areas of the country.

The "market level" losses we considered in this project were those which became apparent or could be assessed only when the animals were marketed. These losses included death and crippling in transportation and handling, carcass bruise damage, condemnations, and loss due to shrink.

We successfully completed 78 test loads, at least 9 in each of the cooperating plants.

Work done at the slaughtering plants was designed to establish rates of loss, the economic significance of the loss, and the possible relationships of various

market level losses to general transportation factors.

At each plant, test lots included those moving by rail and by truck, lots originating at a variety of geographic locations, and lots representing various types of animals, both as to weight and grade, feedlot- and range-feds, and lambs and ewes.

To establish the prevailing practices in handling and transporting sheep and lambs, we spent considerable time in observing movements through various facilities including stockyards, buying stations, packing plants, and auction markets. This included carefully observing movement of animals over the scales, through complexes of alleys and pens, from holding pens to slaughter areas, and during sorting and showing in commission pens and alleys in public yards.

Because of the importance of careful handling during loading and unloading from vehicles, we ran a complete truck survey at one major lamb center with detailed observations as to the condition of the vehicles themselves as well as the handling given the animals. We conducted similar surveys at other points on a more limited scale. Virtually every handling phase fell under the scrutiny of the project leader at one time or another during the test period or during the follow-up period.

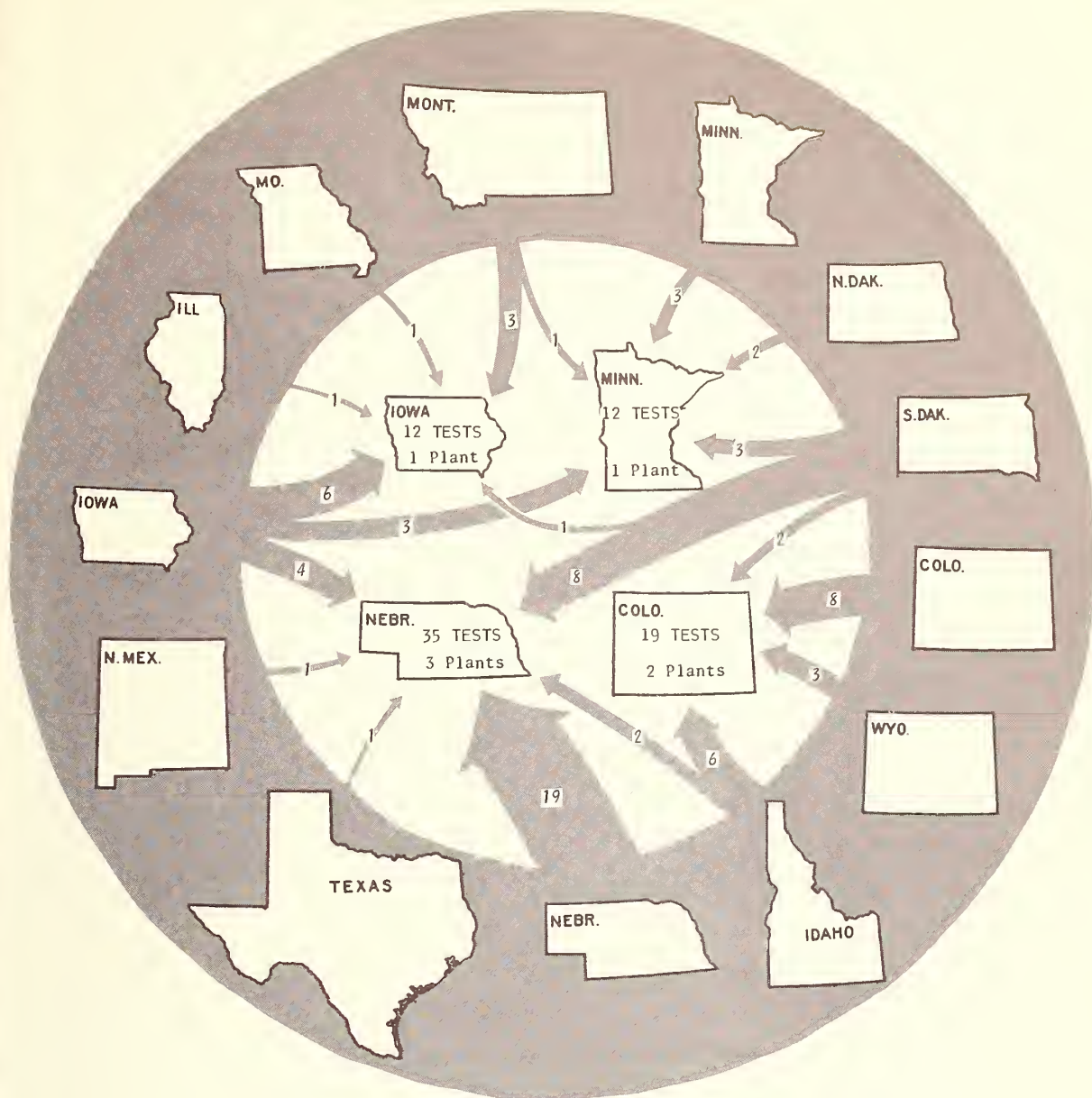


Figure 1

## Origins and Destinations of 78 Test Shipments of Sheep and Lambs Slaughtered at 7 Cooperating Packing Plants

## Market Level Losses

Generally the best way to state loss and damage for comparative purposes is to convert the losses into dollars and cents. We have followed this procedure in this study, as in previous studies in the series. The methods used in the current study for establishing monetary estimates at the market level are explained in the sections that follow.

### Dead Loss

This term includes those animals which arrived at the packing plant already dead or those which died in the yards or holding pens before slaughter. Since these had not been processed, we used current live prices to determine their value rather than prices prevailing for meat. We averaged prices at the Chicago market over a 6-year period, 1954 through 1959, inclusive, and weighted averages on the basis of the total number of sheep and lambs slaughtered under Federal inspection in those years. On this basis the average price for lambs was \$21.56 a hundredweight and the average price for ewes \$5.86 a hundredweight.

With these figures as the monetary factor, we used the average live weight of animals in the test load as the weight factor and multiplied the two to produce the total death loss. For example, if the average live weight was 100 pounds, each animal that died in transit or in the company yards represented a loss of \$21.56. If the animal had been a ewe, the loss would, of course, have been \$5.86. This method of calculating provided a fairly close estimate of the actual loss.

### Condemnation Loss

Where an entire carcass was condemned, we used the same method of loss calculation as for dead loss; that is, live weight times average live price. However, in many instances only parts or a portion of the animal were condemned, such as hearts and livers or actual primal cuts of the carcass such as shoulders, legs, and racks. In these cases we figured the condemnation loss on the basis of carcass meat price rather than live price.

The prices we used were an average of the Chicago wholesale price for lambs for the period 1956 through 1959, inclusive, on the basis of weight and grade. The regular U. S. Department of Agriculture grades were used -- that is, Good, Choice, and Prime, with three weight divisions in the two higher grades, light, medium, and heavy. The Good grade carried a single weight, or all-weight, price. In the case of ewes we determined that a price fixed at two-thirds the value of meat graded Good would be sufficiently accurate.

Meat prices used in this study ranged from approximately 39 cents a pound for Choice lamb to a high of 43 cents a pound for lightweight Prime lambs. We established the value for livers and hearts by consulting with packer representatives who indicated that the average weight of livers was approximately 1 pound and the weight of hearts approximately 0.28 pound.

We further determined that the value of hearts and livers would be approximately one-half the average prices for grades Good through Prime, with a similar rate holding for livers and hearts of



ewes. Thus the value of livers was fixed at 21 cents each, hearts 6 cents, ewe livers 13 cents, and ewe hearts 3 cents.

## Bruise Loss

Bruise loss included both the loss represented by the value of the trimmed away tissue and the carcass devaluation resulting from the trim. We also determined the value of the trimmed tissue by multiplying the weight of the trim times the carcass price of the meat for a lamb or sheep of a given weight and grade.

The devaluation loss was determined by representatives of the packing concern whose experience in the meat trade enabled them to estimate the amount of discount the packer would have to take in order to dispose of the carcass. Usually this loss was stated in so many cents or fractions of a cent a pound, and the loss on a given animal determined by multiplying this loss factor times the dressed weight of the animal.<sup>2</sup>

## Specific Loss Findings

There were 14,589 head of sheep and lambs in the 78 tests conducted in the 7 cooperating slaughtering plants. The three classes of market level losses in this study amounted to \$1,859.41 on these test animals.

On the basis of total 1961 federally-inspected slaughter, this loss rate pro-

jected nationwide would amount to \$1.9 million a year. This compares with a nationwide annual loss of approximately \$22.6 million for hogs and more than \$25 million for cattle.

This seeming disparity between the species is modified somewhat if one considers the relationship of carcass weights. If this is done, then the loss on sheep and lambs is more nearly in line with the other two species.

The breakdown of the total loss figure on the basis of various categories of market level loss is shown in table 1. This loss amounted to \$12.75 per hundred head, with about 50 percent of the total losses falling into the category of condemnation loss and with another one-third



*These carcasses show the result of bruise damage. Note the trimmed places on the rack and loin. Even a relatively small trim can result in substantial economic loss since the entire carcass must be reduced in price before it will be accepted in the meat trade.*

<sup>2</sup>In some cases parts of a carcass, and in one case an entire carcass, were condemned because of bruise damage. These losses are shown under the heading of "condemnation loss" rather than "bruise loss" in the tables and text of this study.

Table 1. - Market level loss per 100 head of sheep and lambs in 78 test shipments

Cause of loss	Loss per 100 head	
Death in transit		\$2.19
Post-slaughter condemnation		
Whole carcasses	\$2.90	
Carcass parts	<u>3.47</u>	6.37
Carcass bruise damage		
Trimmed tissue	.37	
Devaluation	<u>3.82</u>	<u>4.19</u>
All causes		12.75

of the total figure represented by loss due to carcass injury resulting in bruises.

The relationship of the various loss categories to total loss was different for sheep and lambs from the relationship for cattle and hogs. In these other species the bruise factor was considerably more important and the death loss greater than losses due to condemnations.

A closer look at the specific categories of market level loss justifies some additional observations.

### Death Loss

Out of over 14,000 animals in the tests a total of 24 were dead on arrival at the packing plant or died immediately after receipt. This represented a death loss of 16.45 animals per 10,000 head. Although this might not appear to be an excessive figure, it was considerably higher than the death loss rate on previous FCS studies.

Death losses were influenced significantly by adverse weather conditions -- extreme heat or extreme cold. If we had run this series of tests over a longer period of time involving both summer

and winter, we might have had higher losses because of death in transit. Certainly, earlier FCS studies indicated that death losses were considerably higher in cold weather, particularly from December through March. The significance of the death loss figure established in this study lay in the fact that even though the loss rate for 10,000 head appeared low, it still amounted to \$2.19 on every 100 head of sheep and lambs marketed.

### Condemnation Loss

Condemnation loss was broken into two categories -- condemned carcasses and condemned parts (table 1). Of the total loss, carcasses accounted for 45 percent and parts, including organs, about 55 percent. Table 2 shows the various causes of condemnation and their relative significance, both on the basis of parts and carcass condemnation. In this presentation, condemned organs such as livers and hearts were not included although they were included in the total condemnation loss figures in table 1.

Just as for hogs, the greatest single cause of condemnation was pneumonia. As for hogs again, a relationship existed between the incidence of this disease and handling, both from the standpoint of adverse weather and stress conditions. Although not every case of pneumonia was a result of improper handling or of conditions existing during handling and transportation incident to marketing, such a relationship frequently existed and should be considered.

The relationship between handling and transportation and some of the other causes of condemnation was more tenuous, but again we could not rule out such relationship, particularly where animals were in transit for longer periods of

Table 2. - Loss per 100 head due to condemnation of carcasses and parts of carcasses (excluding livers and hearts and sticker grass infestation) by cause of condemnation

Cause of condemnation	Loss on parts	Whole carcass loss	Total	Percent of total, all causes
Pneumonia	\$0.03	\$0.96	\$0.99	29
Arthritis	.19	.31	.50	15
Caseous lymphadenitis	.03	<sup>1</sup> .46	.49	14
Uremia	-	.43	.43	12
Emaciation	-	<sup>2</sup> .33	.33	10
Bruises	.16	.13	.29	9
Hemorrhage/ inflammation	.01	.13	.14	4
Cystitis	-	.14	.14	4
Abscess	.06	-	.06	2
Other	.02	-	.02	1
Total	.50	2.89	3.39	100

<sup>1</sup>All loss due to this cause occurred on ewes. Loss rate per 100 head of ewes only was \$18.07.  
<sup>2</sup>All loss due to this cause occurred on ewes. Loss rate per 100 head of ewes only was \$12.88.

time or where stress conditions were severe. Unusual circumstances and adverse factors might aggravate a condition to the critical point.

By far the most important single loss from condemnation occurred with livers. Approximately 14 percent of all the livers in the test lots were condemned for parasitic infestation, worms, or abscesses. The actual loss from condemned livers amounted to \$2.91 per 100 head. While we could not associate this major market level loss directly with handling and transportation incident to marketing, it did involve handling from the standpoint of animal care. A loss area of this importance deserves the closest attention of producers.

Fifty-seven parts or portions of the carcass (other than organs) were condemned for various reasons indicated in table 2. Of these, 37 were legs, 12 ribs and shoulders, with shanks, loins, and the like, accounting for the remainder. The major cause of leg condemnation

was arthritis. Bruises accounted for around 20 percent of the condemned legs.

Bruise Loss

Table 3 shows bruise loss per 100 head by carcass location, both in cash and in percentage of total bruise loss. As indicated earlier, these figures did not include the value of parts condemned because of bruises. However, both the

Table 3. - Bruise loss per 100 head and relation to total loss on test sheep and lambs by carcass location

Carcass location	Bruise loss per 100 head	Relation to total bruise loss
		Percent
Leg	\$1.15	27.4
Shoulder	.34	8.1
Rack	.70	16.7
Loin	.61	14.6
Other	1.39	33.2
	4.19	100.0



value of the trimmed tissue and the amount of carcass devaluation were included. decline resulted in the number of neck bruises at the various plants.

The breakdown of bruise loss on the basis of carcass location, as shown in table 3, conformed fairly well to previous findings on other species. Hindquarters or legs again accounted for a major portion of the total loss, but it was not nearly as significant for sheep and lambs as it was for hogs, where the ham accounted for about 65 percent of the total bruise loss, or for cattle where the loin or hip area likewise accounted for about two-thirds of the total loss. The catchall category, "other," included shanks and necks for the most part.

In the tests involved in this study, neck bruises accounted for the greatest percentage of the loss classified as "other." This particular loss was probably not truly representative, in that at the time these tests were being conducted the slaughterers were changing slaughter methods. Employees had to become familiar with new techniques and procedures and this, as a consequence, reduced their efficiency in handling animals at the time of kill. During the study, as these new techniques became the regular method of slaughter, the employees gained dexterity. A marked

Table 4 presents an analysis of the significance of bruise injury, insofar as carcass location was concerned. This table was based on the total number of bruises on the carcass involving the trimming away of tissue, weight of the tissue, and the amount of devaluation attributable to bruise injury at this particular carcass location.

For example, there were 440 bruise trims from legs. This tissue weighed 24.75 pounds. A carcass devaluation loss of \$156.90 was attributed to bruise damage to legs. Translated into terms used in table 4, this meant that 27 percent of all trim bruises was on the legs. This trim was 19 percent of the total trim. Legs accounted for 28 percent of the devaluation loss from bruising, with each leg bruised costing 43 cents. Table 4 illustrates rather dramatically the importance of even a single small bruise.

The relationship of trim loss to total bruise loss illustrates especially well the significance of any bruise injury. For cattle and hogs, the value of the trimmed away tissue represented about 37 percent of the total loss from bruising.

Table 4. - Significance of bruise damage by carcass location

Carcass location of bruise	Total bruises trimmed out	Total weight trim tissue	Devaluation loss	Cost per bruise
	Percent			Cents
Leg	27	19	28	43
Shoulder	17	12	8	19
Rack	19	14	17	33
Loin	11	13	15	50
Other	26	42	32	48
Whole carcass	100	100	100	39

However, for sheep and lambs, the trimmed away tissue accounted for only 8.6 percent of the total bruise loss. Thus, even a small bruise had special significance.

On the basis of carcass location, the relationship between trim loss and total bruise loss is illustrated by the following percentages for trim loss: Legs, 6.1 percent; shoulders, 12.9 percent; racks, 6.9 percent; loins, 7.5 percent; other, 10.9 percent. The importance of avoiding any possible injury to legs and racks is thus clearly indicated.

## Two Special Loss Conditions<sup>3</sup>

In sheep and lambs two causes of condemnations deserve special attention because of their economic significance. Since condemnation was a market level loss, we felt that this report should contain some discussion on caseous lymphadenitis and condemnations from conditions brought on by infestation of the animal by wild oats, needle grass, or other "sticker" grasses. This latter condition sometimes resulted in purulent dermatitis. The former condition applied particularly to ewes, although it could appear in other types of animals. The infestation was not related to the age or sex of the animal.

Caseous lymphadenitis, also known as pseudotuberculosis, is a chronic infectious disease caused by a bacillus. The infection probably comes from eating contaminated feed or inhaling contaminated dusts.



*Sometimes extensive portions of a carcass must be cut away and "sent to the tank" as unfit for human consumption because of damage or disease resulting in condemnation. Here a rib cage is being removed because of internal injuries. A major cause for extensive trim is frequently infestation of the skin by "needle" or other forms of "sticker grasses."*

Perhaps in some instances it is due to wound infections which might occur during shearing, docking, and so forth. Obviously this disease is associated with poor animal care, as evidenced by insanitary conditions.

Since the general health of the animal is frequently not materially affected until it is retired from breeding purposes, presence of the disease within a flock often goes undetected. However, it is a major cause of condemnation under Federal meat inspection regulations. Where the disease has progressed extensively, as is usually the case with ewes, the entire carcass may be condemned.

<sup>3</sup>U. S. Department of Agriculture. Miscellaneous Diseases of Sheep and Goats, Yearbook of Agriculture, Keeping Livestock Healthy. 1942.

As table 2 shows, in the tests conducted under this study, this disease accounted for 14 percent of total condemnation loss with all of the carcass loss from this disease involving ewes. The disease may result in condemning parts of the carcass along the invasion route of the infection, particularly those parts closely associated with the lymph nodes.

The market level loss from this disease was extremely significant, particularly with ewes. Control of it lies largely in the hands of the producer. If producers are to expect larger returns from the sale of animals retired from breeding, they will need to reduce the likelihood of these animals suffering from chronic pseudotuberculosis.

The damage done by the invasion of the skin of sheep and lambs by the penetrating awns (stickers) or other parts of grasses and other plants such as foxtail, needle grass, wild oats, and the like, constituted a major loss area at the market level. As is so often the case in bruise damage, this damage also was not usually apparent until after the hide had been removed.

In a way, this was a handling loss because the animals picked up the awns when they were on the range or in pasture. Unfortunately many plants producing the offending awns are also useful for feed and forage at some time during their life.

This, of course, means that it is difficult to wage an all-out campaign to eradicate these plants. It is simply another case where careful handling is called for. Keeping animals off the range or pastures at the time the plants or grasses are producing the stickers will

serve to eliminate the infestation and its ill results.

A trip to the kill floor of a packing plant will show the severity of loss which can occur as a result of infestation. Not only is the trim loss often substantial, but it may be severe enough to cause the devaluation of every carcass affected. Then, too, the stickers sometimes bring about infection which can occur deep in underlying muscles, leading to pyemia and subsequent condemnation for this cause.

Many industry leaders said that this particular loss was of greater significance than the loss from carcass bruise damage at certain plants during certain times of the year. Admittedly this problem will be difficult to control, especially in areas where animals have access to ranges of great area. The problem will call for the cooperation of producers and packers alike.

Producers can help lick the problem by good animal care, making sure to observe the condition of ranges and pastures and keeping their animals off them during the critical period.

Packers can do their part by informing producers of the presence of the infestation in flocks when it is discovered at the time of slaughter. This is not always possible, as the flock may have passed through several hands. But in those cases where it is practical, such information should be passed back to producers. This is especially important since in many western ranges the areas involved are so large that policing them would be almost impossible, particularly with the careful scrutiny that might be necessary to locate the offending plants. Packer cooperation might well help pinpoint the location of the affected area of the range.



## Transportation and Handling Factors

One major objective of this study was to try to relate market level losses to a number of handling and transportation factors. Insofar as possible, we arranged the various slaughter test lots and the supplementary work in the handling and movement at various concentration points to facilitate such analysis.

Doing experimental research work within the framework of day-to-day operations does not allow for the carefully controlled conditions that prevail in laboratories and hence does not yield results as finely definitive. However, the fact that such research is performed under the generally prevailing conditions makes the results more realistic.

### Mode of Transport

Market level losses are frequently associated with the types of carriers or modes of transport used in bringing the animals from farms or ranches to market. For many years, of course, this was largely a rail movement. But beginning in the late 1920's, truck shipments began to increase and have continued to rise at a steady pace until today approximately 80 percent of all receipts at public stockyards arrive by truck. The rails have held on to a fairly good share of the long-distance movement, particularly with hogs moving to the West Coast or livestock moving from the midwestern feeder area to slaughter at East Coast and southern points.

Comparing the loss rates between these two types of transport was the major point of inquiry in the first of the FCS studies of losses in transit. That study indicated the importance of such an

analysis and revealed that truck losses were considerably higher than rail losses. This was particularly true with some of the species, including sheep.

Of the 78 test lots in this study, 16 were rail shipments and 62 truck. On a head count basis, railroads moved 29 percent of the animals and trucks 71 percent. While this may appear to be weighting the sample fairly high on



*These fat lambs are loading into the railroad car easily and quickly with the use of persuaders or "encouragement." This upper deck chute has a moderate rise and smooth sides; however, it would be better without the slight bend at the top. The side rails of the lower deck chute need repair and the posts in the rampway should be eliminated or rounded and protected.*

the side of trucks, this percentage breakdown was not too far different from prevailing transportation patterns. Sheep and lambs move to a greater extent by rail than any of the other species of livestock.

As might be expected, rail shipments involved greater lengths-of-haul than truck shipments and for the most part originated in range areas of the West. We computed the length-of-haul of the test shipments when possible. The average length-of-haul of rail shipments was 718 miles while truck shipments moved 212 miles.

Considering all the various types of market level losses, and without regard to the type of sheep involved, we did not find a great deal of difference in the loss on shipments moving by the two types of carriers. The dead loss was higher on rail shipments by about 50 percent, but bruise loss on truck shipments was double that of the loss on rail shipments. Condemnation loss was half again as high on rail shipments over truck shipments. The total loss was \$14.07 per 100 head on rail shipments and \$12.23 on truck shipments. However, we must look more closely at two factors -- length-of-haul, to be discussed later, and the type of animals involved in the shipment.

Both types of carrier shipped ewes. This must be considered in evaluating any loss data. These animals were generally in somewhat less than a hearty, robust condition and, as has already been noted, were subject to considerably higher losses than lambs were. This was particularly true of condemnation loss. More than twice as many ewes were moved by rail as by truck in this study. If we look at the condemnation rate of all shipments, including ewes,

made by rail, we find that it is approximately 57 percent higher than the condemnation loss suffered by truck shipments. However, if we eliminate ewes from both rail and truck shipments, then we find that the condemnation loss by rail exceeds truck loss by only 23 percent.

Ewes accounted for about 30 percent of the condemnation loss on rail shipments but for only about 10 percent of the condemnation loss on truck shipments. Thus, losses on the test rail shipments would have compared more favorably than those on the truck shipments if there had been an equal number of less desirable animals involved, or if we eliminated ewes entirely.

Although the loss figures from the data assembled in this study did not reveal any startling relationship between the type of carrier and loss rates, shippers should take certain loss considerations into account. These pertain to the actual equipment and the handling procedures and techniques involved in moving sheep and lambs either by rail or truck. These implications will be discussed at a later point in this study.

## Lengths-of-Haul

The livestock industry has long felt that length-of-haul is a major consideration in loss and damage and that losses tend to rise as lengths-of-haul increase. Various studies, including those by FCS, have generally substantiated this point of view. Length-of-haul not only has a relationship to dead loss but is also related to some condemnation losses and to some extent to carcass damage from bruising.

It is not always possible to have complete and detailed information on all



of the factors present during loading or sorting, stops in transit, and unloading. All of these can well have a bearing on ultimate loss. About all that can be done is to confine the analysis on length-of-haul to a consideration of mileage, with some reference to types of carrier and weather conditions (if available).

The lengths-of-haul of the various test shipments ranged from a low of 21 miles to a high of 1,303 miles. Although losses increased as length-of-haul increased, after so-called "mid-distances" were reached, losses began to stabilize and to subsequently decline.

Qualified industry representatives indicated that the possible reason for leveling out of the loss rate after "mid-distances" were reached and for the subsequent decline was the more careful selection of those animals moving long distances than of those marketed close to home. This was also true for packer-buyers making selections for various plants, since they normally sorted purchases into lots. If some animals did not appear healthy, almost certainly they were consigned to lots to be slaughtered at the closest plant.

The fact that animals become accustomed to changes in environment, even as people do, was also generally accepted as a possible reason for the leveling of the loss rate at the "mid-distance" points.

Table 5 compares loss rates by selected mileage blocks on the test shipments. The table shows the percent of total receipts in each of the blocks, the percent of total market level loss on those animals, and the loss per hundred head calculated to include dead, condemnation, and bruise damage.

Table 5. - *Total market level loss per 100 head of test sheep and lambs by length-of-haul*

Miles hauled	Total test animals	Total test losses	Loss per 100 head
Percent			
0-300	40	28	\$9.67
300-600	22	32	19.26
600-900	25	31	16.52
900-1,200	9	8	10.81
1,200-1,400	4	1	2.04
	100	100	12.74

About 87 percent of the test animals moved at distances falling in the first three blocks; that is, mileages not more than 900 miles distant from the point of slaughter. A fairly good number, 9 percent, fell in the next block of from 900 to 1,200 miles. Since only 4 percent moved a greater distance, this small volume probably should be considered in evaluating any results at the longer distance.

The general observations made earlier were substantiated by the data shown in table 5 -- that is, losses tended to increase as length-of-haul increased, then to stabilize and finally decline some.

While a comparison of length-of-haul by type of carrier would have been of added interest, such comparison was not possible since the rail shipments were almost entirely long distance shipments while the majority of truck shipments fell into the first two mileage blocks.

In-transit shrink is another loss factor of considerable interest to the industry. This is the difference in the weight of the animal at the point of origin and the weight at destination -- in this case, the slaughtering point. Here again the accepted rule is that shrink increases



## Carcass Grade

as length-of-haul increases though not at a constant rate and may tend to stabilize at greater distances.

While FCS has not undertaken extensive shrink studies up to this time, some information has been obtained corollary to previous studies and this general conclusion has been found to be true.

We were not able to obtain shrink data on all the test shipments. However, we obtained such data on a rather substantial number of them and the results, as shown in table 6, support previous findings. Shrink increased from 3 percent in the first mileage block to 7.5 percent on those lots moving in excess of 900 miles. The increase was progressive in the early blocks, stabilizing as the distances got greater.

Comparing shrink by type of carrier -- rail versus truck shipments -- was not practical both because of the lack of available data on a sufficient number of shipments and because of the disparity in the lengths-of-haul between the two modes of transport.

Within the limits set forth, the results of this study bear out the positive relationship between various types of loss and increasing lengths-of-haul.

Table 6. - Average in-transit shrink of test sheep and lambs by mileage blocks

Distance hauled	Average shrink
Miles	Percent
0-300	3.0
300-600	5.5
600-900	7.0
900-1,325	7.5

The study dealing with handling conditions and practices causing bruises in cattle established a definite relation between carcass grade and bruise loss. In that study, dramatic increases in loss occurred in the lower grade, with "standard" cattle sustaining losses approximately 3 1/2 times the loss sustained on carcasses grading Choice. Since packing plants have been using a grading system for sheep and lambs in recent years, we analyzed test data to see whether any positive relationship between carcass grade and the various forms of market level loss could be established for sheep and lambs.

Unfortunately, only two of the grades were represented in sufficient volume to allow for proper analysis. These are the Choice and Good grades. Two test lots of animals grading Prime accounted for only a little over 2 percent of the total number of animals in the tests. At the other end of the scale ewes accounted for about 3 percent of the test animals. Thus, 95 percent of the test animals graded either Choice or Good. This must be recognized in analyzing test findings.

On an overall basis, the total market level loss differed very little for animals grading Choice and those grading Good. The breakdown on a grade and loss category basis is shown in table 7. This table presents the data on the basis of dollar loss per hundred head and also gives the same information on the basis of the percentage relationship of the various types of loss to total loss.

The lower grade had higher loss from death in transit and condemnation but the bruise loss category was less than that

Table 7. - Market level losses by type as related to Choice and Good lambs

Carcass grade	Death loss		Condemnation loss		Bruise loss		Total loss	
	Per 100 head	Percent total loss	Per 100 head	Percent total loss	Per 100 head	Percent total loss	Per 100 head	Percent total loss
Choice	\$1.19	11	\$4.97	45	\$4.83	44	\$10.99	100
Good	2.47	23	5.41	50	3.01	27	10.89	100

of the Choice grade. The differences between the two grades, while of interest, did not have the same dramatic impact of the findings on the relation of grade to cattle losses, but they might indicate a relationship nonetheless. Using the data from the test loads of ewes, we found a positive relationship did exist, for the dollar loss from all causes was \$61.14 per 100 head. Of this, approximately 70 percent was condemnation loss.

Now we have already discussed major reasons for condemnations of ewes, and we have indicated the major causes of condemnation in other grades, so it would be reasonable to assume that the lower the grade the more concern must be exercised over the possibility of increased loss due to condemnation in particular.

Although only a few animals graded Prime, we felt that it might be of some interest to determine the relationship of bruise trim loss to total bruise loss, because this would be a particularly good index of the influence of grade on a major area of market level loss. The bruise loss on the animals grading Prime in the tests amounted to \$6.96 per hundred head. Table 7 shows that this was higher than the bruise loss for Choice and Good. In fact, it was more than double the loss suffered on animals grading Good.

While this may cause some consternation at first glance, the reason becomes apparent upon checking the relationship

of the trim-out and its value to the total loss figure. For the Prime animals, the value of the trim was only 3.8 percent of the total bruise loss. For Choice animals, it was 7.3 percent, while for Goods it was 11.8 percent. Thus the higher the grade the more critical was bruise damage of any type, since it was reflected in greater devaluation loss, which in turn brought about a higher total bruise loss.

We were not able to make a thorough analysis of the relationship of weight to loss damage, since the usual breakdown on a weight basis in grade did not extend to the grade Good, and our sample of animals grading Prime was too small.

But we found that the lightweight animals suffered more loss in all categories than the heavier animals. That is, in the Choice grade the overall market level loss was about \$18.34 a hundred for lightweight animals, as against \$5.75 a hundred on the heavyweight lambs. Even on the few Prime grades included in the test we found that bruise loss was considerably higher on the lightweight Primes than on those of medium weight. There were no heavyweight Primes in the test.

### Handling Conditions and Practices

We considered factors specifically related to the actual movement of the animals incident to marketing and

processing that might involve losses. Here we included the equipment and facilities, both stationary and mobile, used in the various handling phases as well as an appraisal of the techniques and procedures used by handlers -- evaluating the influence of people's actions on losses sustained by their animal charges.

A considerable amount of time was spent observing the handling and movement of sheep and lambs at public stockyards, country buying stations and concentration points, and at packing plants. These observations were carried along over a period of time and apply to some of the test lots and to many thousands of head not included in the slaughter tests. The time spent in making these observations was spread over various seasons of the year and over a sufficiently wide geographical area in the midwestern and

western States and incorporated a sufficient variety of lamb handling facilities as to provide a reasonable basis for making the conclusions which follow.

### Holding Facilities

For the most part, we found that holding facilities provided at stockyards, packing plants, and at railroad stockyards were usually arranged to protect the lambs in inclement weather. In most instances a large portion of the total area set aside for lambs was under cover. In those sections of the country where weather during the winter months was apt to be severe, areas were fully enclosed. Apparently transporters and marketers realized that sheep and lambs were especially susceptible to loss and damage from exposure to bad weather.



*Sheep and lambs need extra protection against excessive heat or bitter cold. Exposed to the elements, these animals frequently bunch and crowd, posing the possibility of suffocation. Here we see a typical indoor holding shed at a major public stockyard. Note the feed racks are up out of the way and the pen is well bedded with clean straw.*



Generally speaking, holding facilities were also in good repair and the layouts not overly complex. Moving the animals through the facilities did not entail bewildering traffic patterns caused by poorly planned pens and alleys.

Chutes used in loading and unloading animals from vehicles varied considerably, both as to type and state of repair. The trend toward stairstep chutes was evident at most points, particularly at the public yards and railroad facilities, although a great many ramp-type loading chutes were still in evidence.

At railroad stockyards and at that portion of public yards where rail shipments were loaded and unloaded, the arrangements for double-deck loading of cars were usually quite good. Most places had permanent double-deck chutes of the stairstep type, but at one or two points portable stairstep chutes were in use.

The most obvious hazard observed at railroad loading docks was in the use of cross-over boards leading from the stationary facility to the car. Fortunately the distance between dock and car in most instances was short and the cross-over was on a level. However, the condition of the cross-over was less than desirable in many instances. In a few places proper precaution was not observed in protecting the edges of the cross-over and lambs could fall from the cross-over platform to the deck below. The use of adjustable telescopic gates could remedy this situation.

### Transportation Facilities

In the last 2 or 3 years the use of triple-deck trucks to transport sheep and lambs has increased. A relatively large

number of sheep and lambs have been moving in triple-deck vehicles on the West Coast for some time. Only recently this type of trailer-truck has attained major importance in the Rocky Mountain and midwestern areas.

Using this type vehicle, of course, necessitates changes in facilities at stockyards or packing plants where the animals are to be unloaded. Obviously facilities designed for double-deck vehicles are not adequate for triple-deck vehicles. Understandably, marketers and other receivers hesitate to construct new facilities or make changes in otherwise good and adequate existing facilities unless they believe triple-deck vehicles will become an important way of transporting sheep and lambs.

At the same time, one cannot ignore the increased hazards and likelihood of increased market level loss from bruise injury if some provisions are not made for the safe unloading of triple-deck vehicles. Using adjustable chutes offers one possible solution, and at least one major public stockyard has chutes of this type. In addition, one packer has built a permanent facility for unloading triple-deck trucks. Others are considering it. If triple-decking grows in popularity, it will be highly important that proper unloading facilities are constructed at most major concentration points and packing plants.

Our examination of railroad stock cars used to transport sheep and lambs revealed that while most of these cars had been in use for many years, their general condition was not hazardous. Their principal objectionable condition from the standpoint of safety lay in the fact that a number of them had broken or split side rails. This resulted in

splintered points and sharp edges protruding inside the car. Less than 5 percent of the cars checked had hazardous floors -- those with holes through which legs of small animals such as sheep and lambs could slip, thus bringing about possible cripple loss.

During the course of this study and a preceding general survey of rail equipment by FCS, we observed the upgrading of railroad stock cars to some extent. We believe the rail fleet could be brought into generally favorable status without the expenditure of large sums of money or great amounts of labor and effort.

### Bruise Damage in Slaughter Process

The likelihood of bruise damage during the slaughter process must also be recognized. While for many years the packing industry generally assumed that bruise damage was not likely to occur during this process, research work at Ohio State University conclusively established that carcass bruise injury could occur at any time until the blood pressure approached zero. This research finding is now generally accepted throughout the industry.

There is always danger of injury to livestock moving from holding pens to the actual point of slaughter within the plant because of the time element involved and the frequently complex traffic patterns within the packing plant. Hurrying, pushing, and crowding are almost always present, and too frequently there is excessive use of persuaders.

However, for sheep and lambs the use of persuaders was not the problem in most packing plants participating in these tests. They used Judas goats to expedite

the movement of the lambs to the kill. Personnel at the slaughter point for the most part used noise-makers as persuaders. As previously noted, changes in slaughtering techniques during these tests did occasion difficulties on the part of personnel dispatching the animals, but this is understandable since departures from long-used techniques and procedures always involve readjustment before the worker reaches maximum efficiency in the new process.

The majority of bruise damages occurring at this point involved injury to the neck. This injury did not usually occasion devaluation loss as the loss was confined almost exclusively to the value of the trimmed tissue. Care in stunning the animals and techniques and facilities which allow for immediate sticking will do much to eliminate the damages from bruising and internal hemorrhaging.

### Motortruck Survey

As part of this project, we conducted a survey of motortrucks arriving at a major market. This particular market has long been a major sheep and lamb market and receives animals from a widespread area. Two of the cooperating slaughter plants in this test series were located at this market. From time to time FCS has carried on additional research work at this market on livestock handling. The truck survey was conducted because of the increasing importance of this mode of transport and because the previous research had indicated that losses by truck were of substantial importance. The time was also propitious for a survey at this market because various interests there were particularly concerned over losses to sheep and lambs at the time this project was underway.

We made the truck survey over a period of 6 weeks in the fall of 1960 on various days of the week. We observed the equipment and the handling accorded the animals during unloading at the various facilities around the yard.

While statistics presented in the following paragraphs and in the tables in this section included only findings from this survey, observations made at other public stockyards during the course of this study paralleled these findings. Indeed, the conditions prevailing in handling truck shipments at this yard were no better nor worse than those at other major stockyards and concentration points throughout the country.

We observed 362 trucks during the survey. These vehicles brought somewhat over 55,000 head of lambs to market. Shipments originated in seven States, but 94 percent of the receipts came from four of these States. Sixty-one percent of the observed loads came in semitrailers and 14 percent each arrived in straight trucks or small farm trucks. The remaining 11 percent came in pickup trucks. Of the 55,000 animals unloaded, 135 were dead on arrival and 171 were crippled. This represented a combined dead and crippled loss of \$31.97 per 10,000 head.

This was a high loss, but as we have stated there was grave concern at this particular market at the time this truck survey was conducted. Soon after this survey was completed, the market initiated an intensive campaign to reduce losses both from death and crippling and from bruise injury, giving special emphasis to the information on handling conditions and practices discussed in this report. Since that time the various classes of market level loss have decreased dramatically.

Only 45 percent of the trucks we observed contained dead and crippled sheep. Thus the majority of the trucked-in loads arrived without obvious losses. An intensive campaign aimed at those truckers which did show losses would be worthwhile.

Certain conditions have come to be accepted as "loss-associated conditions," as a result of previous research. These conditions, shown in table 8, generally existed in those loads of animals in which one or more types of loss were apparent.

We analyzed the 163 loads of animals in this survey having dead or cripples. Two-thirds of these trucks had one or more of the loss-associated conditions. Eliminating conditions such as these would go a long way in effectively reducing loss and damage.

Improper loading, observed in 15 percent of the trucks, was the term generally applied to overcrowded vehicles, but it was also used to apply to a few so lightly loaded as to allow for undue shifting of the load. Proper loading is extremely important for sheep and lambs, particularly because lambs usually huddle or bunch, which can result in suffocation.

Table 8. - Incidence of "loss-associated" conditions in trucks containing dead or crippled lambs, or both kinds, at unloading

Condition	Trucks
	Percent
Improper loading	15
Improper or inadequate bedding	16
Improper ventilation (inadequate, excessive, or poorly controlled)	12
Abusive handling	56
No "loss-associated" conditions	33



By inadequate bedding, we meant the failure to use any bedding or to use too much or too little of it, depending upon the circumstances. For the most part the term used in this particular survey applied to trucks which had no bedding. Of course it is difficult to bed an upper deck so that the material remains through the journey. Unfortunately this difficulty results in too many drivers making no attempt at all to bed the upper deck. Serious attention should be given to correcting this situation, because bedding can provide proper footing and help overcome adverse weather conditions.

The term "improper ventilation" in this study referred to the arrangement of the slatted sides, the front ventilators, or the top where under certain conditions either too little or too much ventilation was provided.

The majority of the trucks used for the transportation of livestock are slatted in a manner somewhat similar to railroad stock cars. Frequently the smaller trucks are a combination box type and can be converted to a solid-sided vehicle to transport grain and the like. The semitrailers usually have ventilators at the front which can be used to direct an additional flow of air over the livestock. Most small trucks are uncovered, whereas most semitrailers are covered.

We based our decision on whether to classify a given truck load as improperly ventilated on prevailing weather conditions, the number of animals in the load, and the distance traversed.

Again, ventilation is of special significance to sheep and lambs because these animals often bunch or crowd together.

Abusive handling of the livestock during unloading occurred in the preponderant majority of the trucks with dead or crippled animals. There are many kinds and types of abusive handling. In this survey we included kicking, excessive and unreasonable use of persuaders, forcing animals to jump from upper decks, lifting animals by the wool or pulling them out by the leg, and hurrying animals to such an extent that there are slips, downs, or falls or piling during unloading. Table 9 shows the incidence of these various types of abusive handling on the 91 trucks where we observed such handling.

Excessive and unreasonable use of persuaders was by far the most prevalent form of abusive handling. The use of persuaders was not classified abusive unless it involved applying the persuader with extreme force or in such manner as to force the animal to strike some portion of the facility or equipment in a way likely to cause bruise damage.

In a few instances the use of persuaders was classified as abusive when they were

Table 9. - Incidence of forms of handling abuse observed in trucks unloading with dead or crippled lambs or both kinds

Type of abuse	Trucks affected
	Percent
Handlers kicking animals	22
Abusive use of persuaders	77
Forcing or hurrying animals causing downers, slipping, and piling-up	43
Making animals jump from vehicle or throwing them from upper decks or truck body	23
Lifting by the wool or pulling from vehicle by back legs	22
Instances involving 2 or more types of abuse	66

employed continuously in such a way as to overly excite the animals. Such use was classified abusive because of the increased susceptibility of overly excited animals to carcass damage from bruising and the greater severity likely to prevail in bruises inflicted under these conditions.

We observed all types of persuaders during the course of this survey, but canes and electric prodders were predominant. Many handlers used canvas slappers and, for the most part, used them properly.

In a number of instances more than one type of persuader was used. This was particularly true where two people unloaded the vehicle -- either the driver and a helper or the driver and some other individual present at the time of unloading. Where more than one type of persuader was used, the most frequently used combination was a cane and an electric prod.

In two-thirds of the observed cases, we noted more than one type of handling abuse. Almost always the abusive use of a persuader was one type, with the second type varying somewhat. Where handlers of livestock were inclined to be intemperate or careless, they were not likely to confine abuse of livestock in their charge to a single form.

Virtually all of the handling abuse observed could be attributed to the desire of the driver to unload his truck quickly. Unfortunately, the old adage "haste makes waste" came into play. Not only were there loss and damage but frequently the loading was actually delayed rather than facilitated.

Lifting sheep by the wool has long

been recognized as a major cause of bruise injury. We observed this practice in a few instances during the truck survey. We also saw wool bruises on some of the carcasses of the test animals. Apparently industry has done a reasonably good job in alerting handlers to this abuse because it does not appear to be as serious a problem as it once was. However, this abuse has been replaced by the practice of reaching in and dragging a lamb out of the truck by a leg. Ample evidence demonstrated that this resulted in damage to the leg. The practice should be discontinued.

People in the livestock industry felt strongly that the action of handlers was largely governed by whether or not they liked sheep. Certainly, many handlers think sheep are stupid. If this is the attitude of the handler, you can expect intemperate handling.

On the other hand, some handlers appreciate the follow the leader instinct of sheep and make use of it in their handling methods. You have only to watch unloading by experienced sheep handlers to see that once the animals are started on their way out of the vehicle, they virtually unload themselves. It is much easier merely to assist the lead lamb off the truck and let the others flow naturally after it than to create confusion and consternation by trying to force one off by the abusive use of persuaders.

While it may not be possible to be certain that sheep and lambs will always be handled by those who like them, those who have an investment in these animals will do well to assure themselves that the handling will be done by people who at least understand the peculiarities of the species and act accordingly.

## Livestock Handling Publications Available

Losses of Livestock in Transit in Midwestern and Western States. Marketing Research Report 247. Joseph E. Rickenbacker.

Causes of Losses in Trucking Livestock. Marketing Research Report 261. Joseph E. Rickenbacker.

Handling Conditions and Practices Causing Bruises in Cattle. Marketing Research Report 346. Joseph E. Rickenbacker.

Loss and Damage in Handling and Transporting Hogs. Marketing Research Report 447. Joseph E. Rickenbacker.

Safety-Checking Livestock Handling Facilities. Information 28. Joseph E. Rickenbacker.

## Other Publications Available

The Story of Farmer's Cooperatives, Educational Circular 1.

A Livestock Market is Born. General Report 96. C. G. Randell.

Livestock Pooling -- Improved Marketing Through Grading and Commingling. Marketing Research Report 510. Ira M. Stevens and John T. Haas.

Improving Livestock Marketing Efficiency -- A Study of Nine Cooperative Livestock Markets in Ohio, Indiana, and Michigan. General Report 39. Ira M. Stevens and R. L. Fox.

Livestock Marketing Cooperatives in California -- Their Progress, Policies, and Operating Methods. General Report 98. Raymond L. Fox.

Recent Developments in Farmer Cooperative Meat Packing and Processing. Information 18. Raymond L. Fox.

Motortruck Leasing by Farmer Cooperatives. Information 14. William C. Bowser, Jr.

A copy of each of these publications may be obtained upon request while a supply is available from --

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